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CYBERNETICS RESEARCH AT THE INSTITUTE FOR MACHINES AND AUTOMATION OF THE SLOVAK ACADEMY OF SCIENCES

by Vladimir Nepras

- Czechoslovakia -

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FOREWORD

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[Following is a translation of an article by Vladimir Nemrus in the Czech-language newspaper Rude Pravo, Prague, 27 Jan 63, p 4]

"Autolithography, autolysis, automat, automation - the process of technical evolution, in which automatic arrangements are employed to liberate man from physical labor and of some mental activities . ."

This may suffice. These are the general terms given in the technical dictionary for automation. This brief explanation of concepts is perhaps adequate for some; but, to accomodate those who want to know more about what is new in automation, and what specific work is being done at the Institute for Machines and Automation of the Slovak Academy of Sciences in Bratislava, we went to the top floor of the House of Technique, on Kocel Street.

There are two basic areas of research here, mechanical and mathematical, and, moreover, as may be deduced from the name, a purely theoretical entity concerned with automation. This Insitute's history does not date far back, and automation, as such, was born only eight years ago. The respective workshop of that day was called the Laboratory of Theoretical and Applied Mechanics, and was staffed with two engineers, one technician, and one mechanic. As time went on, the Institute grew, in personnel and equipment.

We are here with one of the research men, a candidate of technical sciences, Engineer S. Petras, and talk about the directions in which the laboratory is headed. A group of specialists is working on a new trend in automation which, compared to the existing ones, should represent a higher quality level. It is known that production processes have heretofore been stabilized through regulation. The idea was either to correct disturbances occurring in a production process, or to prevent them. To this end were employed all sorts of regulators, from hydraulic to electronic. But, it begins to dawn that automation can be achieved by the application of more demanding, qualitatively higher principles And the very group of workers at the Slovak Academy of Sciences is the one that conceived, and elaborated on, these principles.

The various specialists of the Institute are now completing the working theories of the new automatic control, which does not stabilize the production process, but changes it instead. It changes or modifies it so as to attain optimum economic results from the process as a system, by bringing the costs down to economically practical minimum, while raising the overall efficiency to maximum, and turning out the best possible product. In this way, a higher productivity of labor is achieved, independently of the now now common indicators such as the number of workers, total gross output, etc. The new indicators that will be evolved for the control of production, will take into account not just the respective industrial enterprise, but the overall needs of the national economy. Therefore, not as up to now, consider first, and only, the union, the plant, or the group, but only that which, as a whole, is good for the national economy.

By way of an example let us take any enterprise making sheet steel of different types. For the plant itself it was best to fabricate only the heavy gages. The accepted indicators favored this tendency: overall production less costly, gross output rises and thereby the net output as well, all of which makes the plant look good.

But our national economy needs sheet steel of many different types, of thick and thin gages, and in many qualities, for many tens of other enterprises. So it is obvious that what should be done is that which benefits the whole country, and not just one single producer.

And here, according to the new theory, the problem of production control will pass from man to the machine, that is, in our case, a computer. The machine will thus assure the required number of production grades, of predetermined quality. And this is precisely what the Institute for Machines and Automation of the Slovak Academy of Sciences is now working out. This new theory actually represents a change from classical automation to technical cybernetics; it applies cybernetics elements in a scientific way to the field of general theory of control.

This new control method presupposes a good command of three basic elements, in a purely scientific way: A through knowledge of the technology of production (not in the old sense, when often it was not known what material was needed and how much of it, nor about components, auxiliary equipment, energy, etc), that is, exactly what is needed, how much, where, and at what precise time. Therefore, no alchemy, which still is in vogue in so many places. An exact mathematical description of the entire production process is important; it expresses both the quantitative as well as qualitative relations between the economy, technology, and the process control.

Not a small role is played by a thorough knowledge of the economic side of production. It happens even now that in some plants the managers are incapable to realistically evaluate the needs of their own enterprise, much less of the entire national economy.

Last, but not least, the manner of the control process itself is important. Up to now, it was done by the specialist, or engineer-in-charge, or dispatcher, etc. which, in individual stages, was only approximate, and often faulty. Each and every one of these control organs injected into the system some subjective elements, so that the control was in conflict with the overall goal.

Furthermore, of necessity such a process was slow, and unable to react fast enough to demands for quality changes, for instance in regard to raw materials, or technological equipment, etc. All of this, of course, may be complicated, in view of the fact that the control process is actually the result of suitable preparation of various input values, related to the materials and to the technology of the process. So there is no alternative but to replace it with something new, which reflects the changes in the process, and simultaneously adopts whatever corrective

steps may be necessary. All these exacting demands can be met only by a calculating machine.

Of course, the introduction of automation is often resisted by the management itself, as is know from pactice, because they are loath to keep making changes, or just interfere with a seemingly well working system. It does happen that the managers resist changes in process control, for fear of making mistakes or suffering losses. And there are of course also enterprises where the managers are afraid of anyone having a close look at their operations, especially if he is a scientist. They think and argue thus:You are experimenting with us, and maybe prevent our fulfilling the plans. So they are disinclined to accept any changes in the production technology. They cannot see the advantages which such changes may bring tomorrow and in the days to come.

At this time the department of automation of this scientific institution has worked out an algorithm (directives), based on theoretical research, for the control of several production processes. The theory will now be laboratory tested, and in the coming years will be introduced in the Bratislava chemical enterprise Slovnaft.

In front of us, on a giant size table, is spread a schematic diagram of this fuel manufacturing plant. Squares, rectangles, and circles represent individual workshops. Engineer Petras' explanation is clear as to why optimum control must be applied to the known requirements of the plans.

This task will be fed into the computer for direct tryouts of automatic control, even though in any single department of this chemical giant it is first necessary to assure correct results of measurements on all the related equipment, with a view of making an accurate mathematical model of the production process. After collating the needed data, specialists will work out an algorithm for optimum control, which, at the start, will be telemetered from the institute's research center. A simple computer, of adequate speed and capacity, will suffice for the entire plant where, eventually, it will be directly placed. Its capacity will be adequate to take on some additional plants. And then . . . ?

It is assumed that after the laboratory tests are completed, the scientists from the Institute for Machines

and Automation of the Slovak Academy of Sciences will start paying frequent personal visits to other modern industrial enterprises, such as the Eastern Slovakia Iron Works (Vychodoslovenske zelezarny), the Aluminum Company in Ziar on the Hron (Hlinikarne v Ziaru nad Hronom), etc., in order to also work out for them the algorithms of optimum production control.

End

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